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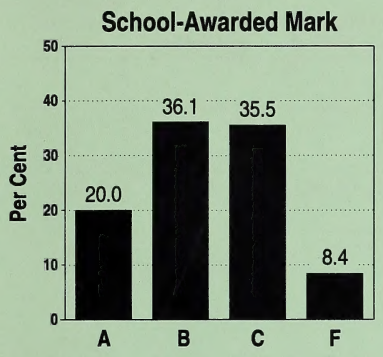
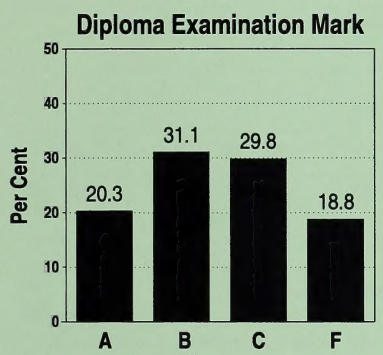
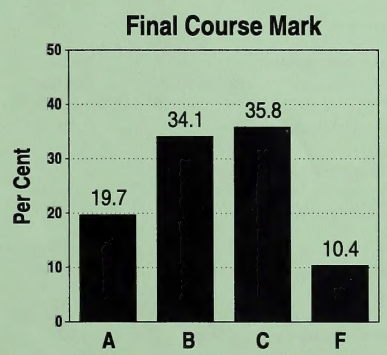
Biology 30

Diploma Examination Results
Examiners' Report for January 1993







The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the January 1993 administration of the Biology 30 Diploma Examination. This information is most helpful when used in conjunction with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Biology 30 Diploma Examination consists of two parts: a multiple-choice section of 70 questions worth 70% and a written-response section of four questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 9 919 students who wrote the January 1993 examination. This represents an increase of 691 students compared to January 1992.

- 89.6% of these students achieved the acceptable standard (a final course mark of 50% or higher).
- 19.7% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Generally, student achievement in Biology 30 was satisfactory. There was an increase (88.5 to 89.6) compared to January 1992 in the percentage of students who achieved the acceptable standard. Most students demonstrated a good understanding of the nature of scientific inquiry as it relates to the study of human physiology. However, many students did not support their explanation of circulation with descriptions of related technologies.

Provincial Averages

- The average school-awarded mark was 66.7%.
- The average diploma examination mark was 64.5%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 66.1%.

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Subtest: Machine Scored

When analyzing detailed examination results, please bear in mind that subtest results **cannot** be directly compared.

Results are in average raw scores.

Machine scored: 49.2 out of 70

Course Content

- Cellular Processes: 3.1 out of 4
- Homeostatic Mechanisms: 2.1 out of 3
- Nutrition and Digestion: 6.6 out of 10
- Body Fluids: 6.3 out of 8
- Breathing, Gas Exchange, and Transport: 4.0 out of 6
- Energy Release: 0.8 out of 1
- The Kidney: 7.0 out of 10
- Regulation of the Internal Environment: 9.4 out of 14
- Voluntary Movement and Body Support: 3.0 out of 4
- Human Reproduction: 6.9 out of 10

Process Skills: 4.6 out of 7

- Multiple-choice questions 16, 18, 32, 41, 60, 69, and 70

Cognitive Levels

- Knowledge: 19.6 out of 25
- Comprehension and Application: 21.8 out of 33
- Higher Mental Activities: 7.8 out of 12

Machine-Scored Blueprint

Each question on the examination is classified in two ways: according to the curricular content area being tested and according to the cognitive level demanded by the question. The examination blueprint illustrates the distribution of questions in January 1993 according to these classifications.

	Machine Scored			
Reporting Category	**Knowledge**	**Comprehension and Application**	**Higher Mental Activities**	**Examination Emphasis (%)**
Cellular Processes	1, 3, 7	2		4
Homeostatic Mechanisms	4	5	6	3
Nutrition and Digestion	9, 13, 14,	8, 10, 11, 12, 15, 18	16	10
Body Fluids	17, 19, 23, 24	20, 21, 22, 25		8
Breathing, Gas Exchange, and Transport	26, 27	28, 29	30, 32	6
Energy Release	31			1
The Kidney	33, 34, 41	35, 36, 37, 38, 39, 40	42	10
Regulation of the Internal Environment	43, 44, 45, 48, 54	46, 47, 49, 50, 51	52, 53, 55, 56	14
Voluntary Movement and Body Support	57	58, 59	60	4
Human Reproduction	61, 68	62, 63, 64, 66, 67, 70	65, 69	10
Examination Emphasis (%)	**25**	**33**	**12**	**70**

Subtest: Teacher Scored

Results are in average raw scores.

Teacher Scored: 15.2 out of 30

- Question 1: 5.1 out of 10
- Question 2: 1.8 out of 4
- Question 3: 3.0 out of 6
- Question 4: 5.4 out of 10

Process Skills: 10.1 out of 20

- Questions 2, 3, and 4

Teacher-Scored Blueprint (Written Response)

Each question in this section is designed to measure student achievement of two or more course objectives. Furthermore, students are expected to use a variety of cognitive skills to construct satisfactory responses.

	Written-Response Section	
Question Number	**Question Description (Concept, Cognitive Levels, and Process Skills)**	**Mark Value**
1	Comprehending concepts of circulation. Evaluating theories. Applying examples of technology. Communicating clearly and logically.	10
2	Applying concepts of cellular respiration. Identifying variables.	4
3	Comprehending body responses controlled by the ANS. Interpreting data.	6
4	Identifying variables. Evaluating experimental designs. Interpreting data.	10
	Total	**30**

This examination has a balance of question types and difficulties. It is designed so that students capable of achieving the acceptable standard would obtain a mark of 50% or higher and students capable of achieving the standard of excellence would obtain a mark of 80% or higher. This examination is different in structure from the January 1992 Biology 30 examination in that it contains four instead of five written-response questions, for a total of 30 marks. The maximum value of any one written-response question is 10 marks. The four questions require students to use a variety of thinking skills, all of which go beyond, but are not isolated from, the ability to recall core concepts. One question requires students to relate technology to the development of science concepts.

Approximately 15.3% of the students who wrote the examination in January 1993 and received a school-awarded mark had written at least one other Biology 30 Diploma Examination during the August 1991 to August 1992 period. This subpopulation (1 522) achieved an examination average of 62.0%, compared to 64.9% for the population (8 397) whose first writing of a Biology 30 examination was in January 1993. However, the group of students who rewrote (1 522) increased their examination average score from 46.9% to 62.0%.

Approximately 58.2% of the students who wrote the examination were female. Approximately 79.6% of this female population achieved the acceptable standard on the examination, compared to 83.4% of the male population.

Multiple Choice

Question	Key	Difficulty*	Question	Key	Difficulty*	Question	Key	Difficulty*
1	D	77.1	25	A	91.6	49	B	73.4
2	C	65.3	26	A	76.7	50	D	54.0
3	B	86.6	27	C	79.6	51	A	60.3
4	B	70.3	28	B	64.8	52	B	62.3
5	D	67.8	29	D	68.3	53	B	60.9
6	A	75.2	30	D	67.3	54	D	81.5
7	C	84.1	31	B	82.5	55	D	86.9
8	D	53.5	32	C	38.6	56	B	64.2
9	A	86.7	33	D	72.8	57	C	73.3
10	C	55.6	34	A	89.5	58	D	87.8
11	A	61.3	35	B	75.6	59	B	75.9
12	C	63.5	36	C	60.5	60	B	63.1
13	C	79.7	37	D	83.0	61	A	89.1
14	C	65.7	38	A	61.2	62	B	57.1
15	B	49.4	39	B	62.1	63	B	55.7
16	B	64.6	40	A	36.7	64	C	78.3
17	B	83.8	41	C	77.6	65	B	70.1
18	C	81.2	42	D	82.7	66	C	71.4
19	D	88.9	43	C	56.7	67	A	58.6
20	C	86.0	44	C	75.7	68	C	77.8
21	C	65.2	45	B	68.4	69	A	47.5
22	B	71.0	46	D	47.0	70	A	85.6
23	A	84.2	47	A	54.3			
24	B	58.6	48	C	90.7			

*Difficulty—percentage of students answering the question correctly

Machine-Scored Section
(Multiple-Choice Questions)

For a complete breakdown of student responses by alternative for the multiple-choice questions, please refer to the school and jurisdiction reports.

Most students who achieved the acceptable standard interpreted experimental data that was presented in simple diagrams, graphs, or word descriptions (questions 2, 18, and 41). They made predictions (questions 5 and 52) and related physiological concepts to everyday experiences (questions 17, 28, and 58). Most of these students translated into words symbolic representations of biological functions (questions 6, 22, 30, and 49). They recognized and provided definitions for biological terms (questions 1, 3, 7, and 44). They sequentially ordered the major steps of physiological processes (questions 27 and 60). They understood basic functions of human body structures as assessed by many questions, but found it difficult to make functional comparisons among body components (questions 24 and 67).

Students who achieved the standard of excellence, in addition to fulfilling the expectations identified above, interpreted interrelated sets of data presented in complex tables or graphs (questions 16, 32, and 69). They analyzed multistep human physiological problems (questions 11, 12, 15, 38, and 66). They formed correct inferences from extracurricular data (questions 10, 47, 51, 56, and 65). They identified significant parts of human organs and recognized their specialized functions (questions 36, 39, 40, 46, 53, 62, and 63).

Detailed statistics and comments follow on four questions.

Percentage of Students Correctly Answering Selected Machine-Scored Questions

Student Group	Question Number 16	24	30	66
All students	64.6	58.6	67.3	71.4
Students achieving the standard of excellence (80% or higher, or A) on the whole examination	90.6	89.1	90.3	94.0
Students achieving the acceptable standard who received marks between 50% and 64%, or C, on the whole examination	54.5	47.2	59.8	65.3
Students not achieving the acceptable standard (less than 50%, or F) on the whole examination	36.9	28.0	41.9	41.8

Use the folowing information to answer question 16.

Possible Procedures to Demonstrate Chemical Digestion of Food

Test tube	1	2	3	4
Diagram				
Substance	egg white	potato	butter	bread
Enzyme	pepsin	pepsin	amylase	amylase
Incubation	37°C for 24 h	37°C for 24 h	37°C for 24 h	37°C for 24 h
Test applied after 24 h	Biuret reagent	Sudan IV	iodine solution	Benedict's solution and heat

16. Which two test tube procedures would produce results that indicate food was digested chemically?

A. 1 and 3
• **B.** 1 and 4
C. 2 and 3
D. 2 and 4

Question 16 required students to identify the main class of organic nutrient that was present in each food. Secondly, they had to determine if the enzyme that was present in the tube digested the nutrient in the tube. Finally, they had to recall which of the four tests identify products or substrates of protein, starch, or lipid digestion. Most students (83%) chose test tube 1. Most students (76%) also chose test tube 4 as a correct procedure. However, many students then combined one of these two correct responses with test tube 2 (17%) or test tube 3 (24%). It is difficult to identify which of the three steps in this complex question students did not understand. The data do suggest that the concepts of lipid identification and digestion present more problems for students than the concepts of carbohydrate identification and digestion. The table above shows what percentage of students in each of three achievement classifications chose the correct combination of tubes 1 and 4.

24. One difference between blood and lymph is that **only** blood contains

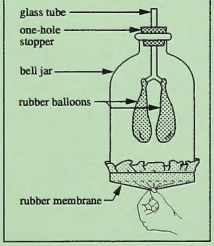
A. leukocytes
• **B.** erythrocytes
C. inorganic ions
D. protein antibodies

Question 24 required students to recall the composition of blood and lymph and then compare the two body fluids. Scientific language that is integral to the Biology 30 course was used in the alternatives. Many students did not understand that the lymphatic system contains components that function in the immune system. Leukocytes or protein antibodies were selected by 32% of the students. This suggests that the role of lymph nodes is poorly understood by many students. However, the students who achieved the standard of excellence on the examination had little difficulty with this question (see table page 4).

30. The apparatus shown in the diagram at the right could be used to demonstrate that breathing is a result of

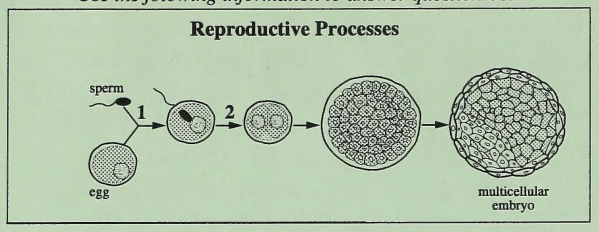
A. movement of the ribs
B. elasticity of lung membranes
C. diffusion across thin membranes
• **D.** change in the size of the thoractic cavity

An Apparatus to Demonstrate Breathing



Question 30 required students to understand the mechanics of breathing in the context of a common demonstration model. All the alternatives presented correct ideas about the breathing system. Two of the concepts (distracters A and C) could not be demonstrated using the model. Distracter B described a structural characteristic of lungs but not a cause of breathing. It was chosen by 20% of the students. The selection of the keyed response (D) required students to have a spatial sense and to mentally manipulate an object. They also had to understand the relationship between the volume and pressure of gases. Approximately 75% of the male population selected the keyed response (D) whereas 62% of the female population chose the keyed response.

Use the folowing information to answer question 66.



66. Where do processes labelled 1 and 2 normally occur?

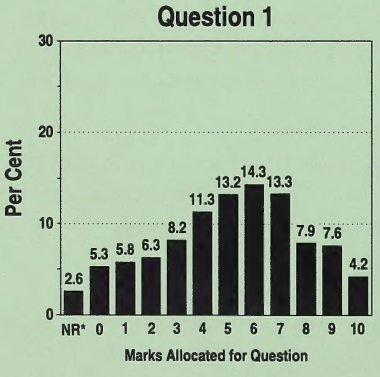
- **A.** Process 1 occurs in an ovary and process 2 occurs in a Fallopian tube.
- **B.** Process 1 occurs in a Fallopian tube and process 2 occurs in an ovary.
- • **C.** Processes 1 and 2 occur in a Fallopian tube.
- **D.** Processes 1 and 2 occur in the uterus.

Question 66 required students to identify two reproductive processes (fertilization and cleavage) and recall the sequential arrangement of three female reproductive structures. Students also had to understand the functions of these three structures as they relate to fertilization and cleavage. This question was answered correctly by most students (71.4%); nonetheless, 19% of the male population and 17% of the female population did not understand where fertilization normally occurs and chose either alternative A or D. Approximately 24% of the male population and 20% of the female population thought that cleavage occurs in either the ovary or the uterus and chose either B or D.

Written Response

The four questions in the written-response section are designed to assess achievement on five of the 10 content strands for Biology 30. In addition, Question 1 required students to describe several technologies that could be used to support their theoretical explanations. Question 4 required students to analyze and evaluate experimental designs and scientific data. To answer Question 4, students were expected to draw on their understanding of process skills as developed throughout the Biology 30 course. All four questions required students to apply their understanding of biological concepts to problems in mammalian physiology.

Responses to the written-response section indicated that most students approached the examination seriously and made a commendable effort. Each question was attempted by at least 96.6% of the students. A few students (0.1%) achieved full marks on each of the four questions. However, approximately 45.8% of the students obtained less than 15 marks out of 30 on the written-response section. Many students presented facts they could recall but did not relate them directly to the problems posed by the question. This was particularly evident in student responses to Question 1.



NR*–No Response

Question 1: Most students (97.4%) attempted to answer this question. Students have a general understanding of the human circulatory system. Therefore, many students presented as much information as time and space would allow. However, most students did not address the problem that was presented by the context. Rather than limiting their answer to describing the structures and functions that promote the "circular" flow of blood, most students took the reader on a tour of the whole system. Many even described the composition of blood and its functions, particularly with reference to gas exchange. Too often, capillaries and one-way valves were mentioned only in passing.

The average score obtained for biology concepts was 3.1 out of 5 marks.

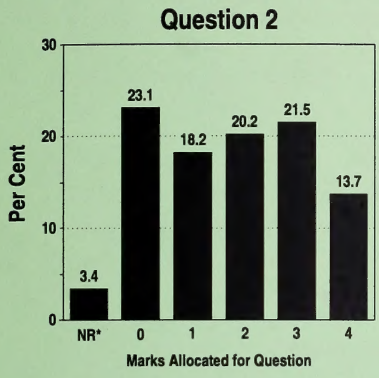
Most students did not provide descriptions of discoveries in science and technology that support the current theory of circulation. Since many students did not fill in the gap Harvey left in his explanation (significance of capillaries), the microscope was rarely mentioned. Students who did describe technologies too often chose those that are used to promote circulation—e.g., pacemaker, cholesterol-free diets—rather than those that provide evidence for the theory of circular blood flow. Common classroom technologies were often overlooked.

The average score obtained for technologies was 0.8 out of 3 marks.

Many students presented two pages of script in paragraph form, and some included illustrative sketches. However, since many students did not focus on the problem, logical arguments and connections were frequently missing.

The average score for communication skills was 1.1 out of 2 marks.

On this 10-mark question, the average mark was 5.07 or 51%.



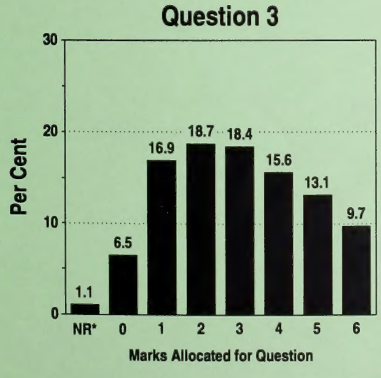
NR*–No Response

Question 2: Most students selected test tube 3 as the culture that would produce the greatest amount of ATP. To obtain 1 mark for this correct choice, however, students had to state that tube 3 provided optimal conditions for aerobic (cellular) respiration. Many students did not provide this specific explanation for their choice. They simply described the tube's contents (repeated the data). In comparing tube 3 to the other three tubes, many students did not relate the ingredients of each tube to the process of cellular (aerobic) respiration. The roles of oxygen, glucose, and vitamins in cellular respiration were not explained.

Some students selected test tube 4 as the culture that would produce the greatest amount of ATP. They stated that the stopper would keep the ATP from escaping. Many students classified test tube 1 as the control and therefore viewed it as having no potential for cellular respiration.

Approximately 78% of the students who achieved the standard of excellence on the examination obtained 3 or 4 marks out of the 4 marks allotted for this question. In comparison, approximately 86% of the students who failed to achieve the acceptable standard on the examination obtained 1 mark or less for this question.

On this 4-mark question the average mark was 1.78 or 44%.



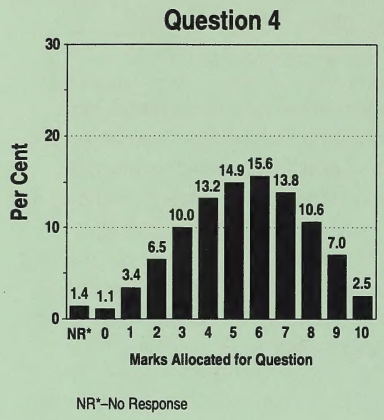
NR*–No Response

Question 3: Most students selected subject 1 as the most relaxed and therefore obtained 1 mark for *part a*. Those students who chose another subject could still obtain marks for *part b* if they presented correct explanations for the physiological effects that supported their choice. For example, subject 4 was chosen for *part a* by many students. These students could still obtain 5 marks for *part b* if they correctly explained five supporting physiological effects. It should be noted that a heart rate of 75 beats per minute can be interpreted as falling within the normal adult range, particularly for females. Many students chose a theme such as adrenaline or parasympathetic stimulation and then provided explanations for the effects in reference to the theme. Most students presented clear and concise answers. The answers were well organized and dealt with the physiological effects in a logical and sequential order. Students lost marks primarily because they restated

the data rather than providing an explanation. Of the six effects, peristalsis and thyroxine levels were most poorly understood.

Approximately 61% of the students who achieved the standard of excellence on the examination obtained 5 or 6 marks out of the 6 marks allotted for this question.

On this 6-mark question, the average mark was 2.95 or 49%.



NR*–No Response

Question 4: Many students demonstrated a good understanding of the processes used in solving problems scientifically. They could interpret the data provided and therefore identify relationships between variables (part a), and form generalizations about factors that regulate heart development (parts c, e, and f). Many students could develop reasonable hypotheses to account for unequal growth in right and left heart chambers (part g).

Part b was answered poorly by most students . The process skill of determining patterns and trends in data by using the "best fit" line for graphs was not adequately understood. Only a minority of students actually drew lines on the graphs in order to determine accurate readings for time = 0 h (at birth). Some students used time = 6 h instead of time = 0 h because values were plotted for 6 h. Many students expressed the differences qualitatively instead of quantitatively and therefore received a maximum of 1 mark for *part b*.

In *part d*, many students did not come to grips with the key concept of sample size and reliability. Many students had difficulty in differentiating between sample size and size of heart. They reasoned that if a greater number of pigs were used, then the average value would increase since many hearts obviously weigh more than two.

In *part h*, many students provided responses that dealt with environmental factors; e.g., young pigs have not been exposed to pollution. Many students did not understand the connection between the problem of investigating the development of heart tissue and the maturity of the animals used. Relatively few students thought of the choice in ethical terms; i.e., that pigs are preferable to humans as experimental subjects.

Approximately 60% of the students who achieved the standard of excellence on the examination obtained 8 or more marks out of the 10 marks allotted for this question.

On this 10-mark question, the average mark was 5.36 or 54%.

For further information, contact Lowell Hackman or Phill Campbell at the Student Evaluation Branch, 427-0010.